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G03-1514 Use of Feed Contaminated with Fungal (Mold) Toxins (Mycotoxins)

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G1514

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The purpose of this NebGuide is to provide guidelines on use of mycotoxin-contaminated feeds.

Mycotoxins are chemicals produced by fungi (molds) under certain conditions. They are not essential for fungal growth or reproduction, and they are toxic to animals or humans. They are naturally occurring chemicals found in grains, food and feed consumed by humans and animals that cannot be completely avoided. Accordingly, we try to control the amount of such chemicals ingested by humans and animals.

Mycotoxins commonly found in grains or feeds used in Nebraska are aflatoxins, ergot alkaloids, fumonisins, vomitoxin and zearalenone. Information about their health effects, diagnosis, and treatment may be found in NebGuide 03-1513, *Understanding Fungal (Mold) Toxins (Mycotoxins)*. Information about sampling and analyzing grains or feed for mycotoxins may be found in NebGuide 03-1515, *Sampling and Analyzing Feed for Fungal (Mold) Toxins (Mycotoxins)*.

Use of Mycotoxin-Contaminated Feeds

It is always safest not to use mycotoxin-contaminated or moldy feed. Even if no detectable amounts of **known** mycotoxins are present in such feed, unknown or uncharacterized mycotoxins may be present which cannot be detected using existing analytical methods. If mycotoxin-contaminated or moldy feed must be used, feed it to animals that are less sensitive to potential adverse health effects of mycotoxins.

There are many different kinds of mycotoxins belonging to many different classes of chemicals. It is difficult, if not impossible, to generalize about the sensitivity of different species to adverse health effects caused by ingestion of mycotoxins. But ruminants are generally among the least sensitive to mycotoxins.

U.S. Food and Drug Administration (FDA) can establish limitations for concentrations of mycotoxins in animal and human foods. Limitations are labeled using different terms, including "action levels" for aflatoxins, "guidance levels" for fumonisins, and "advisory levels" for vomitoxin. USDA Federal Grain Inspection Service has set standards defining ergoty barley, mixed grains, oats, rye, triticale and wheat. The legalities of such designations and their application to animal production are beyond the scope of this NebGuide. The authors recommend that grain, feed and animal producers adhere to those limitations as much as possible.

Limitations placed on mycotoxins in feed are listed in *Table I*. If federal agencies have not established limitations for a mycotoxin, then we have listed recommendations for limitations found in a published reference. References are listed for all mycotoxins included in the table.

Blending Feeds to Reduce Mycotoxin Concentrations

Blending contaminated feed with uncontaminated feed to reduce mycotoxin concentrations is regulated by federal agencies. Blending food or feed containing a substance in excess of a limitation established by a federal agency may not be permitted. Blending aflatoxin-contaminated commodities **is not permitted**. The final product produced by blending may be unlawful, regardless of the concentration of the mycotoxin attained by blending.

Under certain circumstances, U.S. FDA may not object to blending feeds containing mycotoxins at concentrations higher than a limitation. In the case of aflatoxin in Nebraska corn harvested in 2002, the State Department of Agriculture requested permission from the U.S. FDA to blend corn containing aflatoxin under certain circumstances. Limitations were placed on uses for the blended products, however. Limitations applied to feed blended for marketing or for use by the grain producer. Before you blend mycotoxin-contaminated feed, contact the State Department of Agriculture for additional information.

If mycotoxin-contaminated feed is to be blended, then mycotoxin content of the uncontaminated and contaminated feeds must be known. Hopefully, the content of the uncontaminated feed will be very low. The following formula can be used to calculate the percentage of contaminated feed in the blended feed to achieve a specific mycotoxin concentration:

$$F = 100 \times (C - L)/(H - L)$$

Table I. Action or recommended maximum concentrations of mycotoxins in animal feeds.

Mycotoxin	*Commodity*	*Animal*	*Maximum Concentration in diet*	*Remarks*	*Reference*
Aflatoxin (action levels)	Corn, peanut products, other feeds or feed ingredients	Finishing (feedlot) beef cattle	300 ppb		FDA/ORG Compliance Policy Guides (CPG) 7126.33, Sec 683.100
		Breeding beef cattle, breeding swine, mature poultry	100 ppb		
		Finishing swine > 100 lb	200 ppb		
	Corn, peanut products, or other feeds or feed ingredients, excluding cottonseed meal	Immature animals	20 ppb		
	Cottonseed meal	Beef, cattle, swine, poultry (regardless of age)	300 ppb		
	All feeds or feed ingredients	Dairy animals, animal species not listed above, uses not listed above, intended use unknown	20 ppb		
Ergot	Barley	Standards define ergoty grain products under federal grain quality regulations. They are not listed by animal species.	≤ 0.1% ergot sclerotia	Some references indicate adverse health effects may occur at concentrations beginning at 0.1% in the diet.	7 CFR 810
	Mixed grain		Predominately wheat or rye: ≤ 0.3% Other mixed grains: ≤ 0.1%		
	Oats		≤ 0.1%		
	Rye		≤ 0.3%		
	Triticale		≤ 0.1%		
	Wheat		≤ 0.05%		
Fumonisin (recommended levels)	Corn and corn byproducts	Equids (horses)	5 ppm (≤ 20% of diet)		US FDA, Final Guidance, Nov 9, 2001
		Swine and catfish	20 ppm (≤ 50% of diet)		
		Breeding ruminants, breeding poultry, lactating dairy animals, laying hens	30 ppm (≤ 50% of diet)		
		Ruminants ≥ 3 months old, raised for slaughter	60 ppm (≤ 50% of diet)		
		Poultry raised for slaughter	100 ppm (≤ 50% of diet)		
		All other species or classes of livestock	10 ppm (≤ 50% of diet)		
Vomitoxin (deoxynivalenol, DON) (advisory levels)	Grain and grain products	Swine and other animal species, except cattle and chickens	Swine: 5 ppm (≤ 20% of diet) Other species: 5 ppm (≤ 40% of diet)		FDA advisories from 1982 and 1993
		Ruminating beef and feedlot cattle older than 4 months, chickens	10 ppm (≤ 50% of diet)		
Zearelenone	Diet	Prepubertal gilts	< 1 ppm		Osweiler (1996): 421
		Sexually mature sows, bred sows	< 3 ppm		
		Young boars	< 20 ppm		
		Mature boars	< 200 ppm		
		Virgin heifers	< 10 ppm		

where F = fraction of contaminated feed in the final blend expressed as a percentage, C = desired mycotoxin concentration in the final blend, L = mycotoxin concentration in the "uncontaminated" feed, H = mycotoxin concentration in the contaminated feed. H must be greater than L.

For example, say corn was available contaminated with zearalenone at 10 ppm and is to be mixed with corn containing no detectable amount of zearalenone (detection limit 0.5 ppm) to a concentration of no more than 1 ppm. Using the formula to calculate F: C = 1 ppm, L = 0.5 ppm (safer to use the detection limit concentration than to assume there is no zearalenone in the uncontaminated corn), H = 10 ppm. Plugging the numbers into the equation and performing the calculations:

$$F = 100 \times (1 - 0.5)/(10 - 0.5) = 100 \times (0.5/9.50) = 5.26\%$$

Since we want the blended grain to contain no more than 1 ppm, it would be better to round F down to 5 percent, so the blended grain should not contain more than 5 percent contaminated corn.

References

Anonymous (2000) *Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed*, US EPA Industry Activities Staff Booklet (www.cfsan.fda.gov/~lrd/fdaact).

Code of Federal Regulations (CFR), Title 7, Section 810 - Agriculture, Official US Standards for Grain, Jan 1, 2001 (www.access.gpo.gov/nara/cfr/cfr-table-search.html).

Guidance for Industry: Funmonisin Levels in Human Foods and Animal Feeds, US FDA, Center for Food Safety and Applied Nutrition, Center for Veterinary Medicine, Nov 9, 2001 (www.cfsan.fda.gov/~dms/fumongu2.html).

Osweiler, G.D. (1996) *Toxicology*, *The National Veterinary Medical Series*, Williams & Wilkins, Media, PA: 409 ff.

US Department of Agriculture (USDA) Grain Inspection, Packers and Stockyards Administration (GIPSA) Backgrounder - Deoxynivalenol (DON), November 2001. (www.usda.gov/gipsa).

US Federal Drug Agency (FDA), Office of Regulatory Affairs (ORA) Compliance Policy Guides (CPG) 7126.33 Sec. 683.100 - Action Levels for Aflatoxin in Animal Feeds, Issued Nov 21, 1979, reissued Oct 1, 1980, Revised Aug 15, 1982, May 18, 1989, and Aug 28, 1994 (www.fda.gov/ora/compliance_ref/cpg).

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